QCD-NP-B Physics

Recent Results & Plans

Christos Leonidopoulos

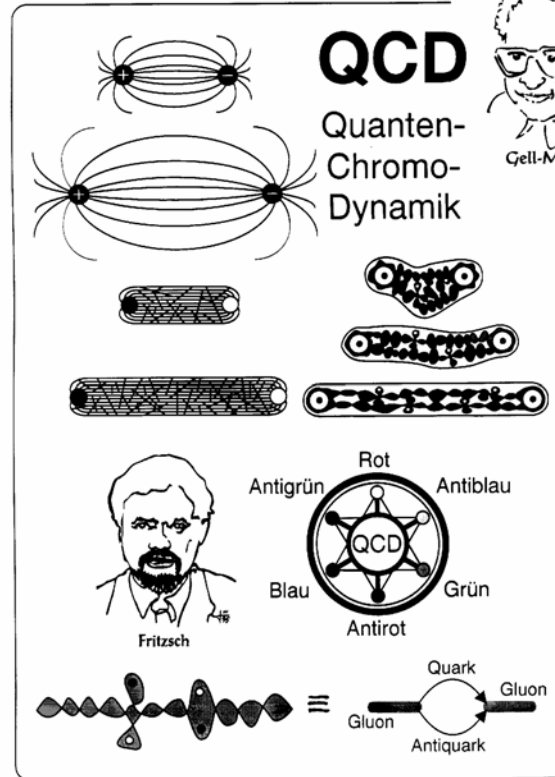**Columbia University**

DØ Collaboration Meeting

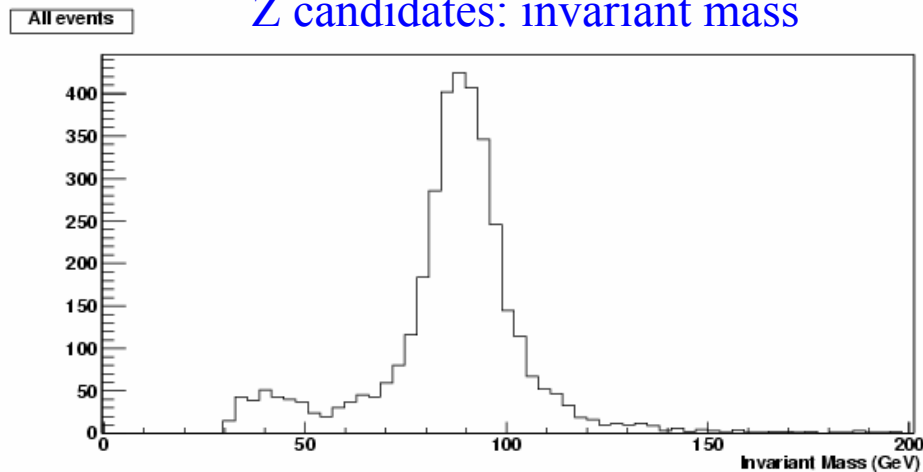*FNAL* **- October 10, 2003**

QCD

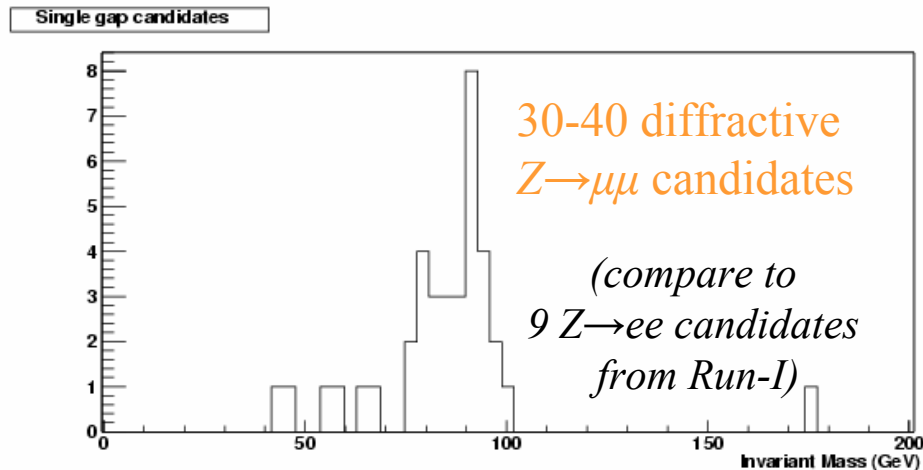# Diffractive Z production
(a.k.a. Rapidity gaps)

Z candidates: invariant mass

All events

LP03 selection cuts

Single gap candidates

30-40 diffractive
$Z \rightarrow \mu\mu$ candidates
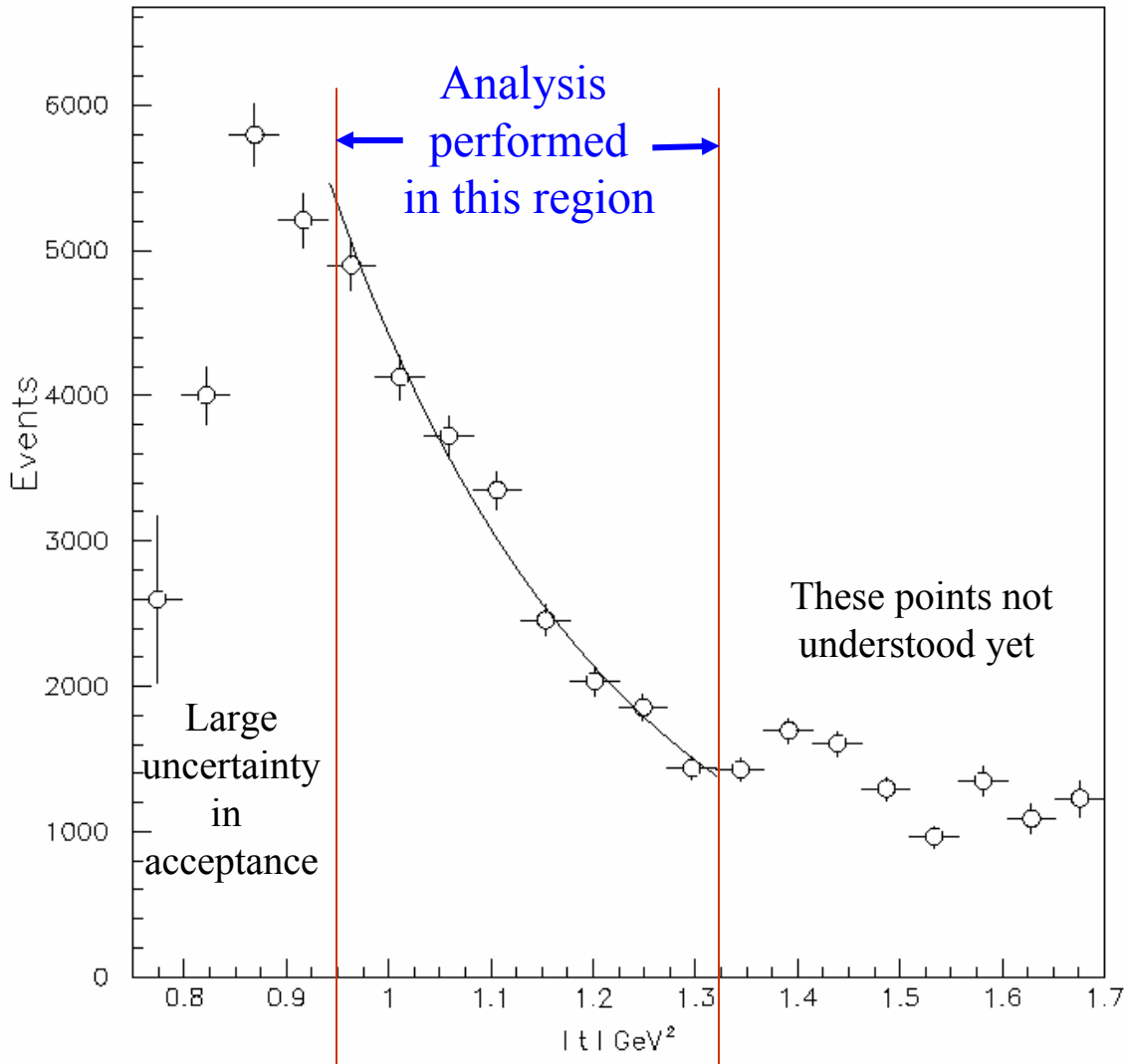
*(compare to
9 Z→ee candidates
from Run-I)*

LP03 selection cuts +
rapidity gap requirement

(gap definition not final)

Tamsin Edwards

Not shown outside D0 yet

dN/dt spectrum (elastic $p\bar{p}$)

Analysis performed in this region

Large uncertainty in acceptance

These points not understood yet

Events

| t | GeV²

- First measurement performed in this t region!

- Using standalone FPD data

- All 18 FPD detectors fully commissioned by end of shutdown
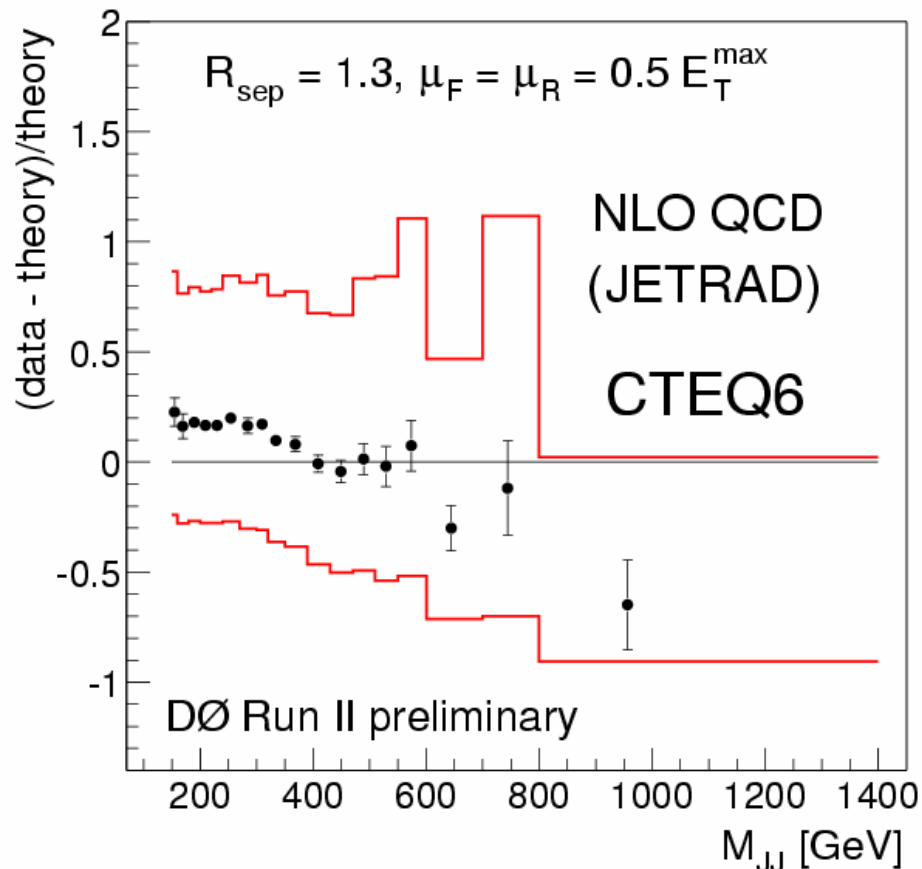
Slope after fit & unsmearing:

$$b = -4.015 \pm 0.193 \, \text{GeV}^{-2}$$

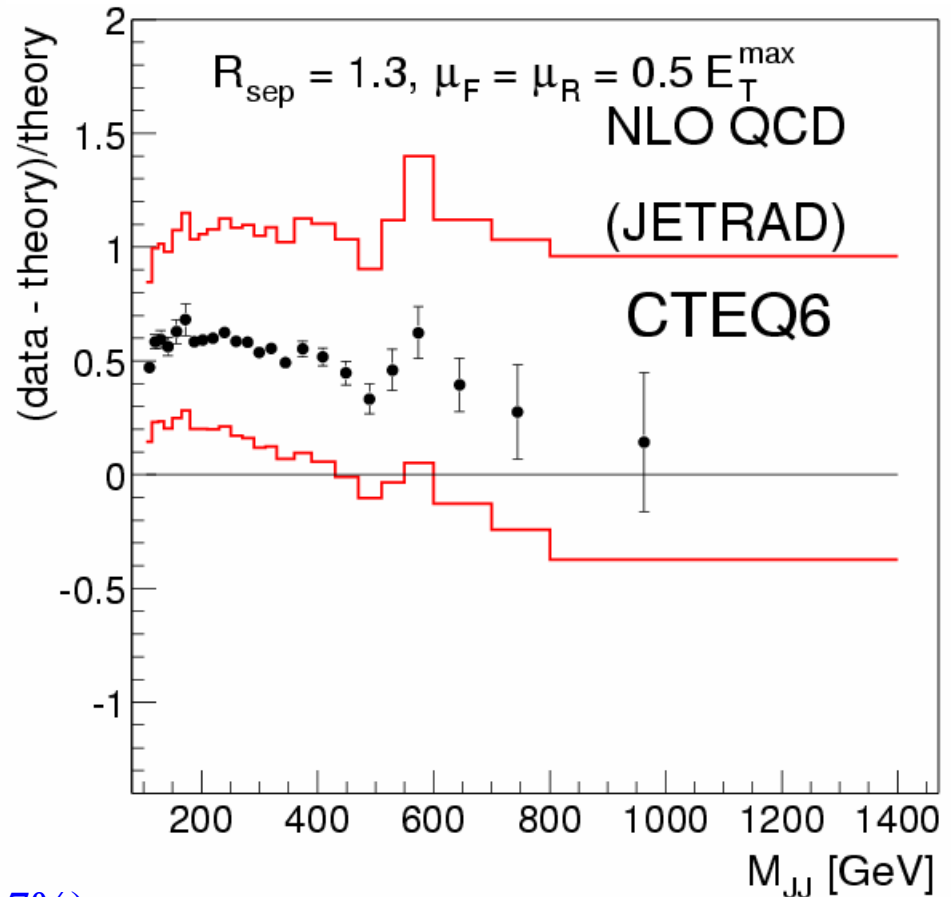Jorge Molina

Not shown outside D0 yet

Jet cross-sections

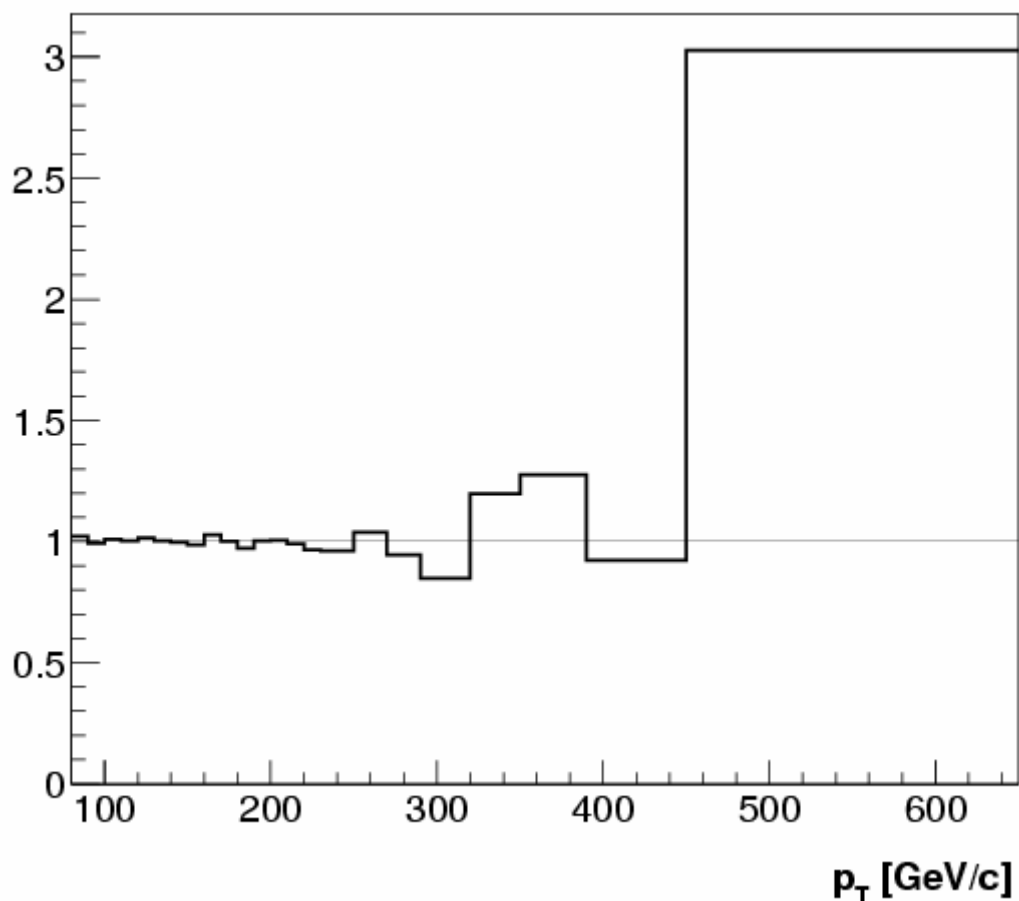D0 preliminary result for Moriond
(p13.06 data; old JES corrections)

same data set; new JES corrections
(post-Beaune calculations)

JES problem? (too high by ~ 6-7%)

QCD group working hard on JES studies

Not shown at summer conferences
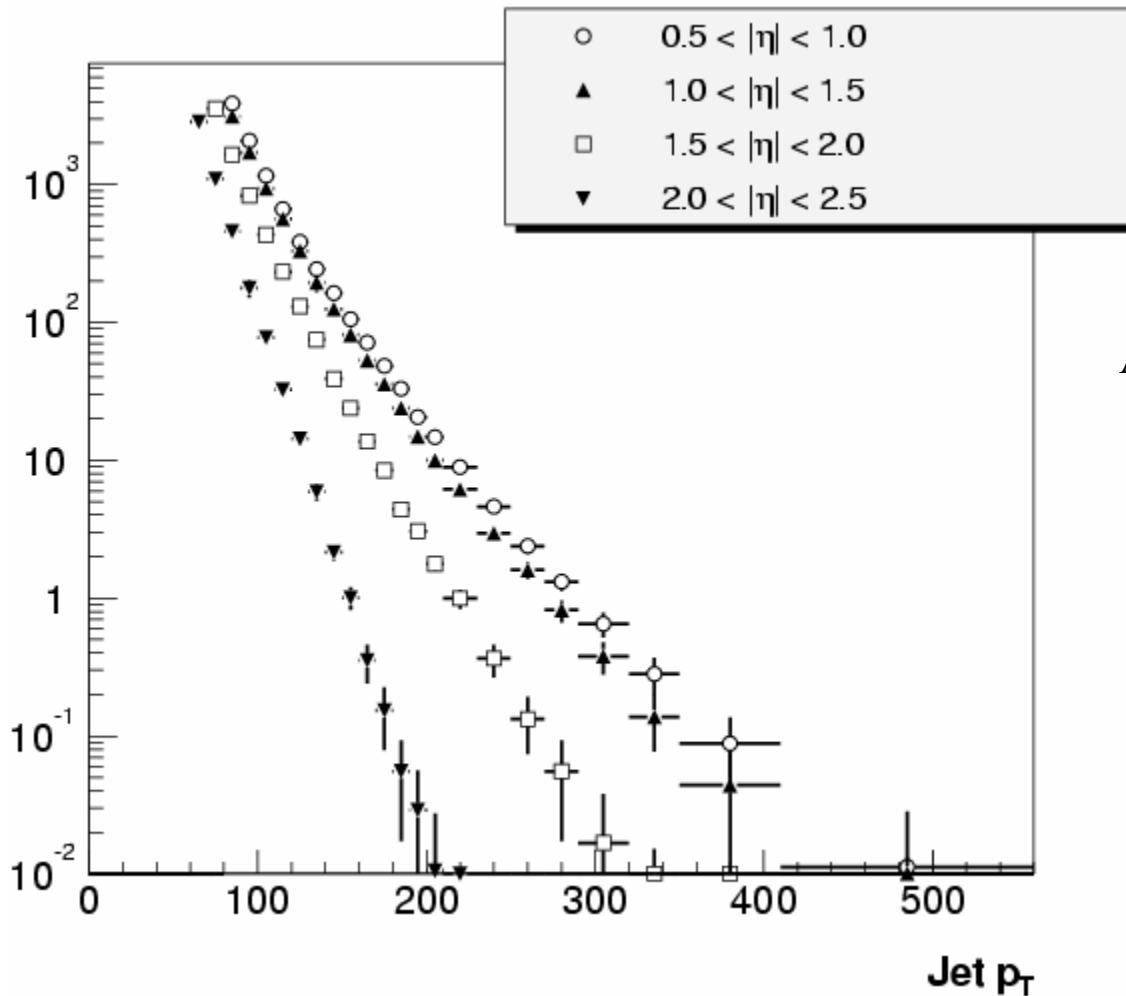
Jet cross-sections (2)

(pre-Moriond data)/(post-Moriond data)
ratio of p_T distributions
(w/o JES corrections)
- Good compatibility between data sets
- *This is a JES effect* (for both sets),
  not a problem in post-Moriond data

A ~ 2% error on JES gives
a ~ 20% error on cross section
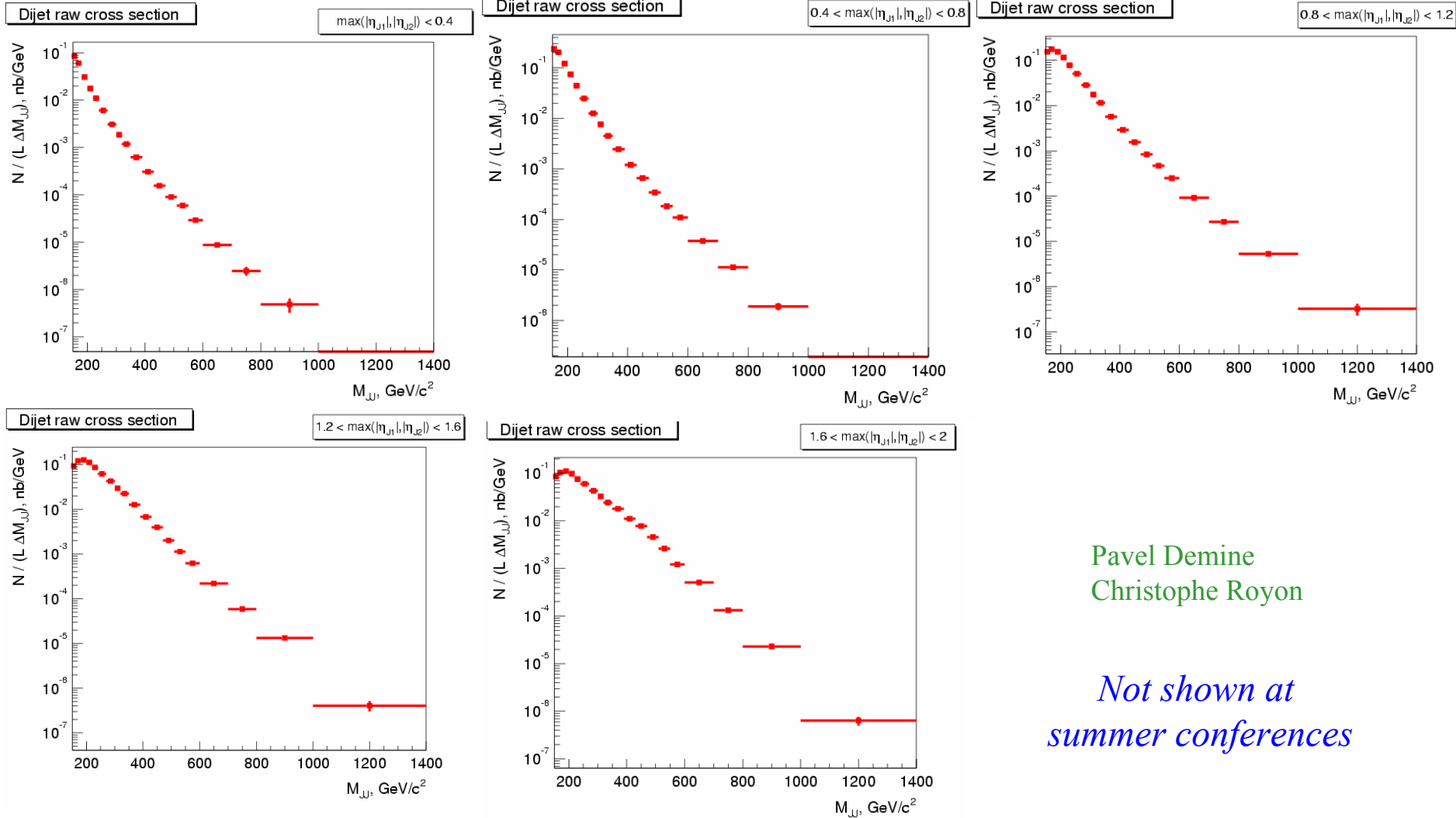
Raw p_T distributions

All corrections have been computed
except unsmearing (JES issue
has to be sorted out)

Jean-Laurent Agram
Christophe Royon

Not shown at summer conferences
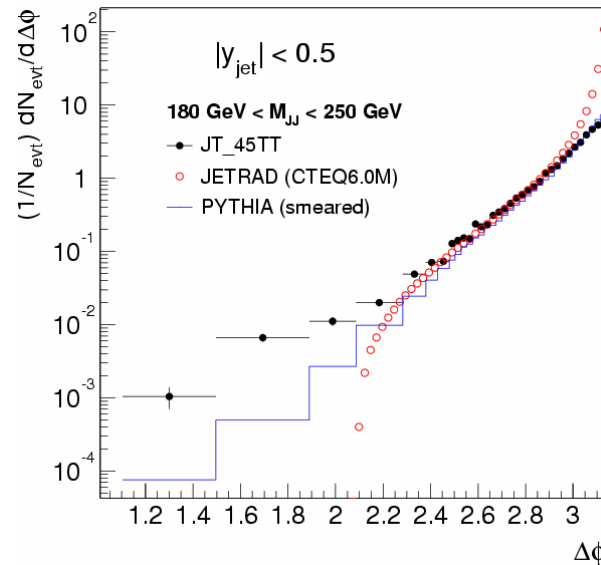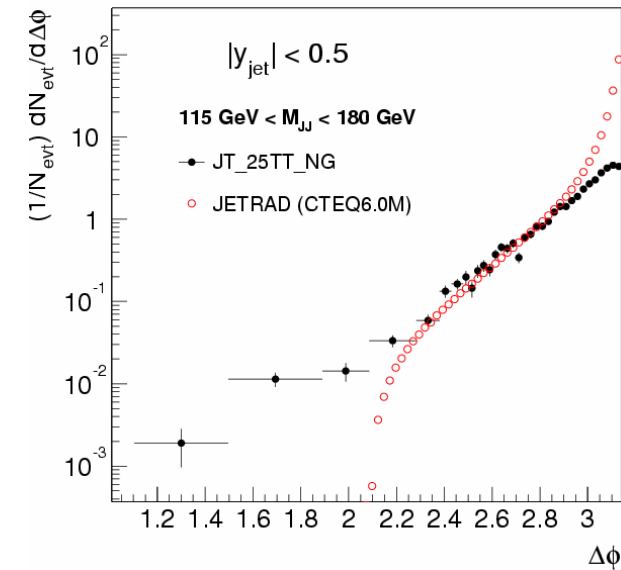
Raw dijet mass cross section
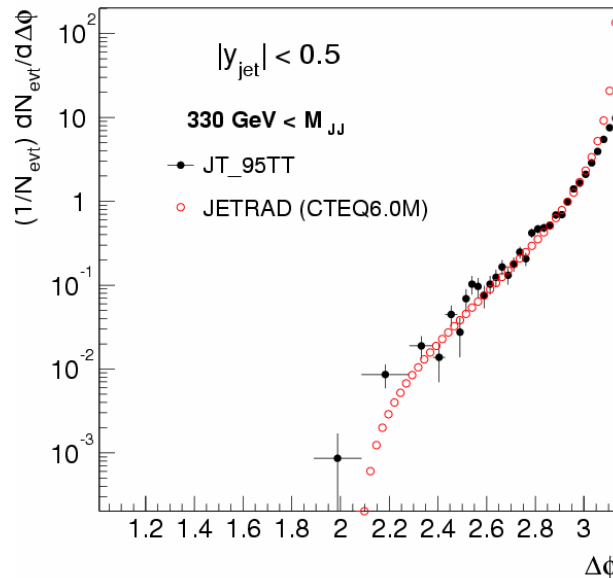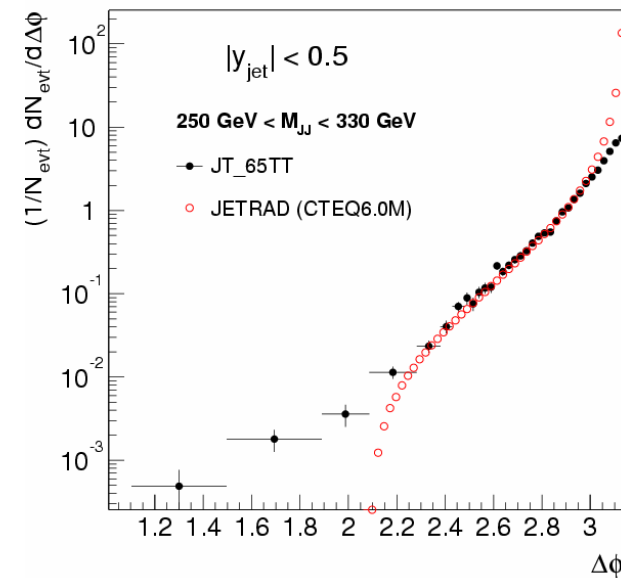

Pavel Demine
Christophe Royon

Not shown at summer conferences

All corrections have been computed except unsmearing
(JES issue has to be sorted out)
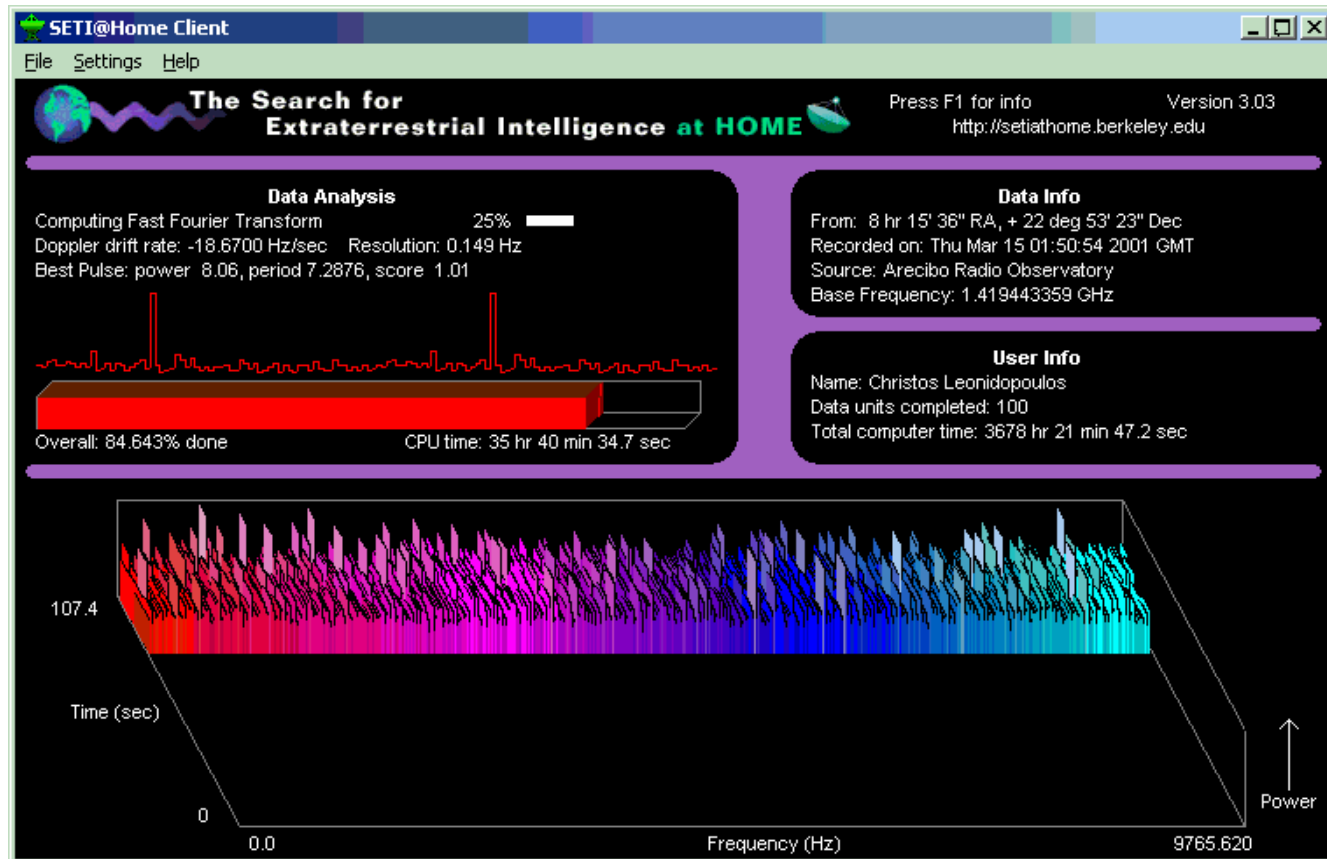
Studies on $\Delta\varphi$ between jets

- Good agreement between data & NLO QCD for medium $\Delta\varphi$ values

- Disagreement at low $\Delta\varphi$ values (i.e. *high order effects*)

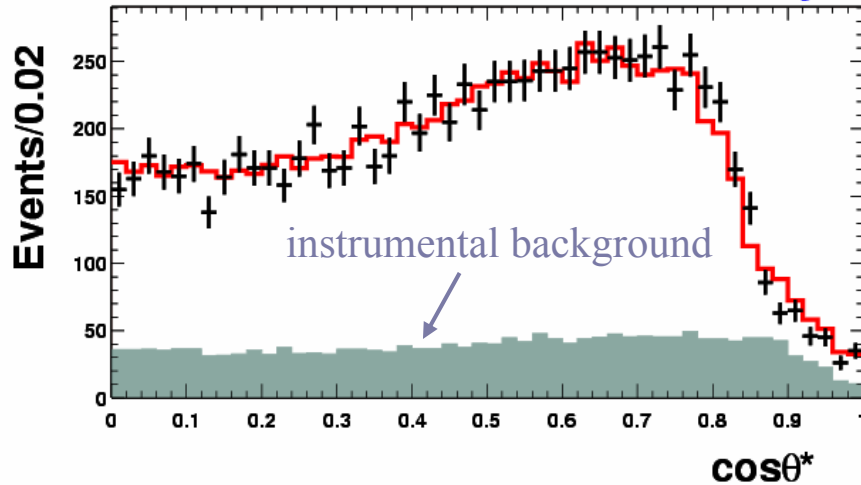Alexander Kupco

Not shown at summer conferences

New Phenomena
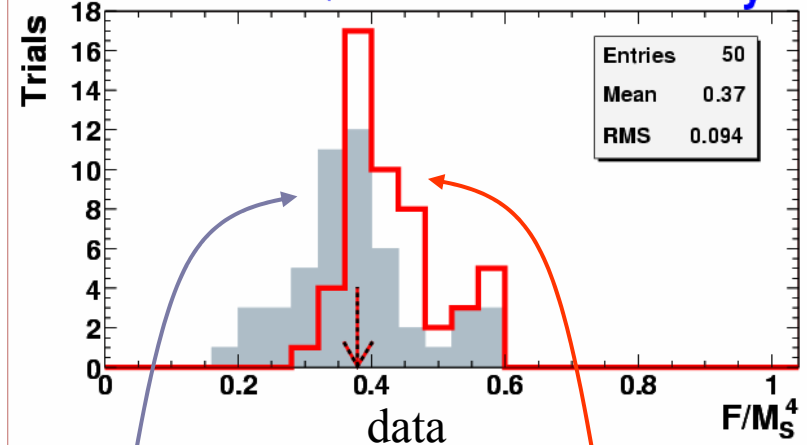
Large extra dimensions search: e^+e^-, $\gamma\gamma$

diEM cosθ* Spectrum — DØ Run II Preliminary

instrumental background

η_G Sensitivity — DØ Run II Preliminary

Entries 50
Mean 0.37
RMS 0.094

data

F/M_S^4

bayesian limit
(MC ensemble)

likelihood limit
(MC ensemble)

diEM Mass Spectrum — DØ Run II Preliminary

ED signal for η_G=0.6
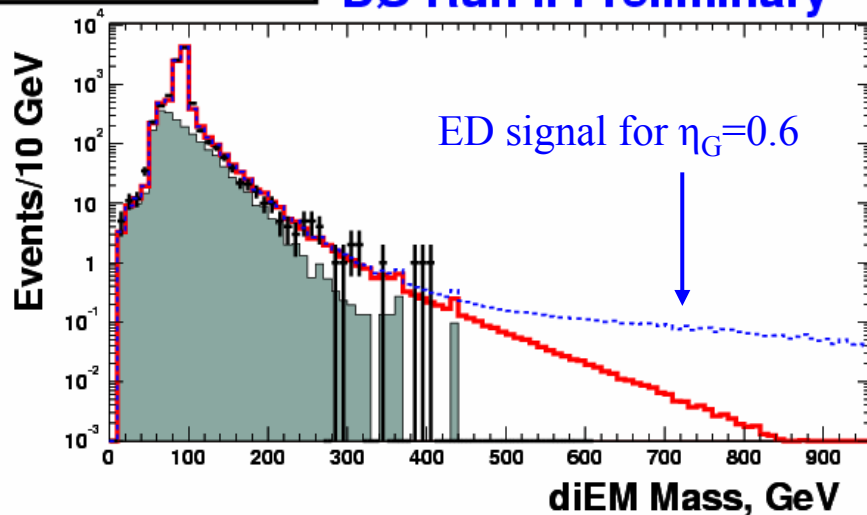
New limit on fundamental
Planck scale (MP) : > 1.28 TeV
(GRW convention)

Greg Landsberg

(LP03)

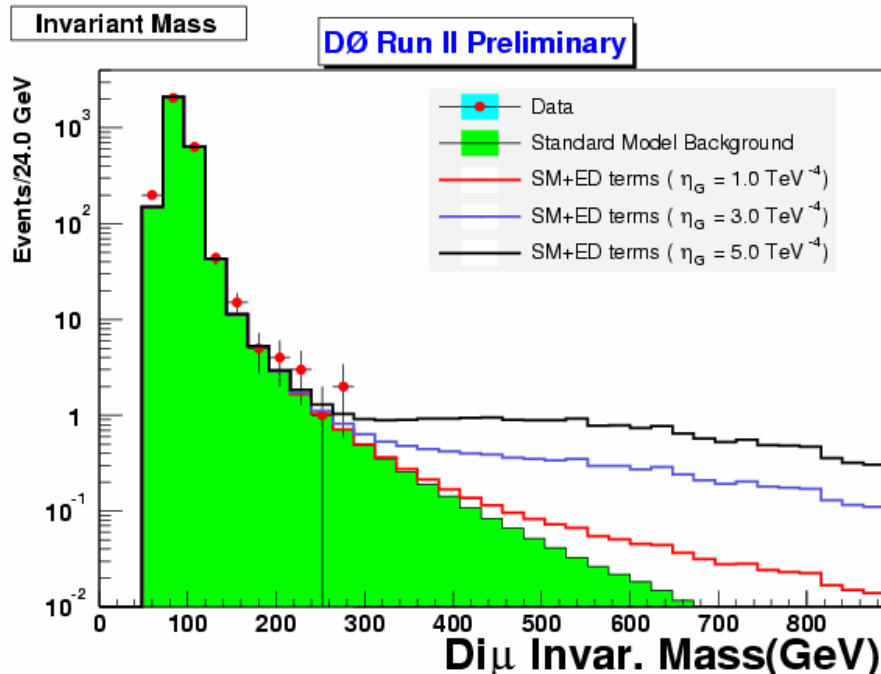# Large extra dimensions search: $\mu^+\mu^-$
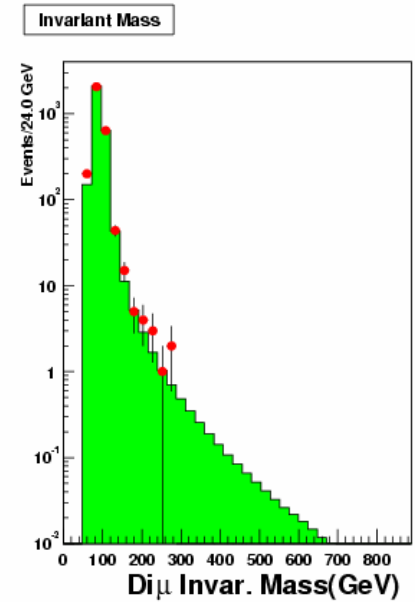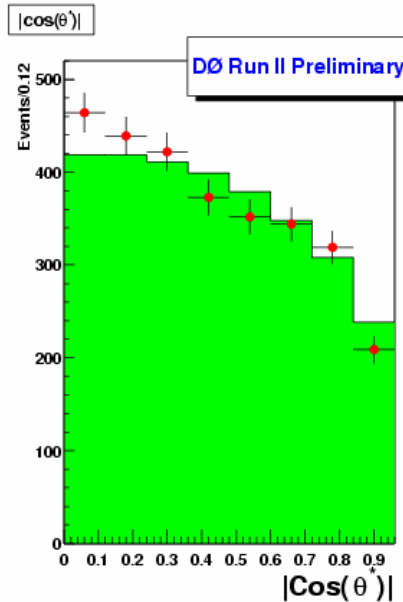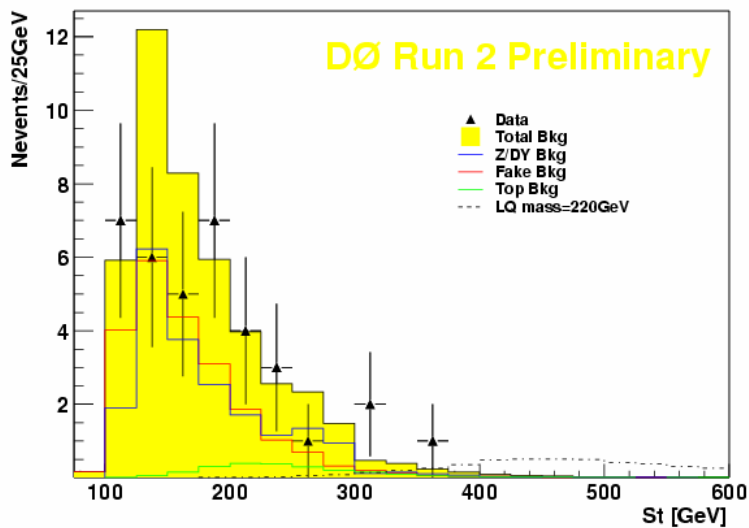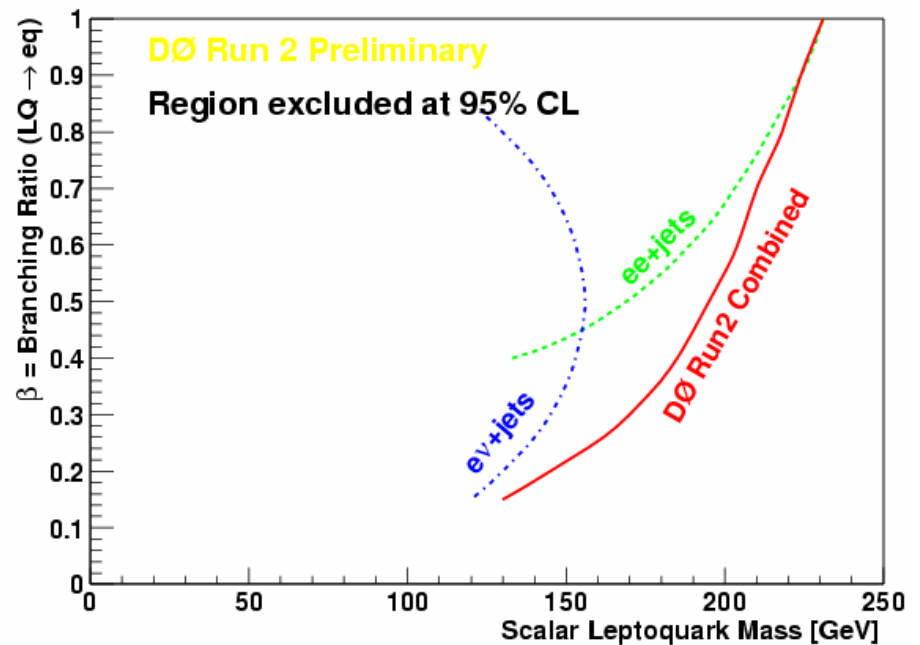

Fundamental Planck scale: > 880 GeV
at 95% C.L. (GRW convention)

Ryan Hooper, Greg Landsberg

(LP03)

1ˢᵗ generation leptoquarks search: e^+e^-
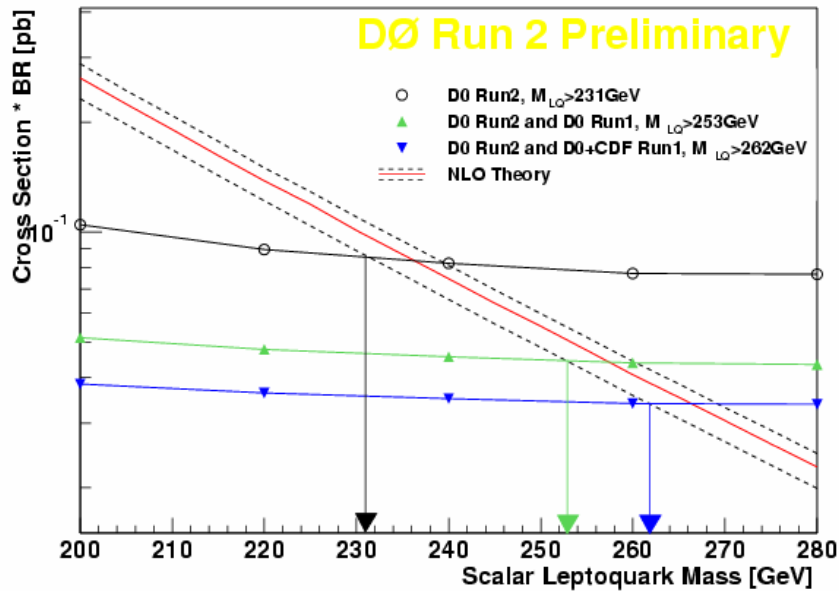
Shaohua Fu, Vishnu Zutshi

(LP03)

QCD-**NP**-B   Christos Leonidopoulos

1ˢᵗ generation leptoquarks search: *e v*

ST12 = EtEM + MET + Etj1 + Etj2 for MET > 30 GeV

— Total Bkg
● Data sample

$\beta = BR(LQ \rightarrow eq)$

Scalar Leptoquark mass   GeV

Cross Section*BR [pb]

Scalar Leptoquark Mass [GeV]
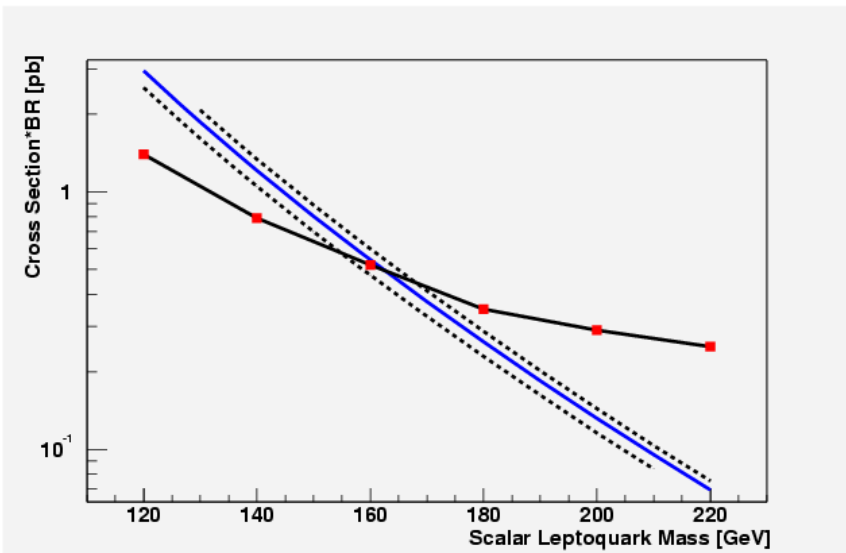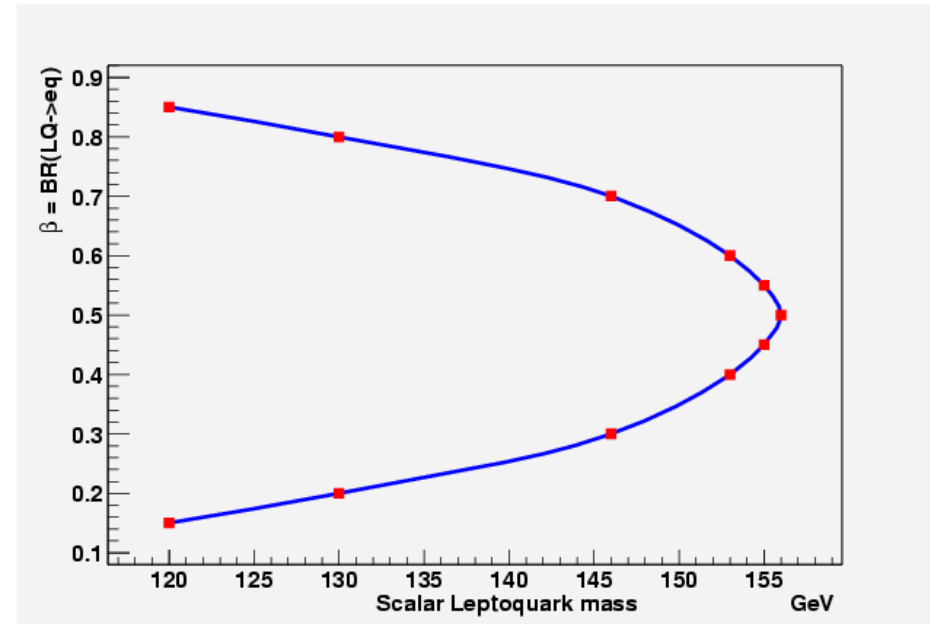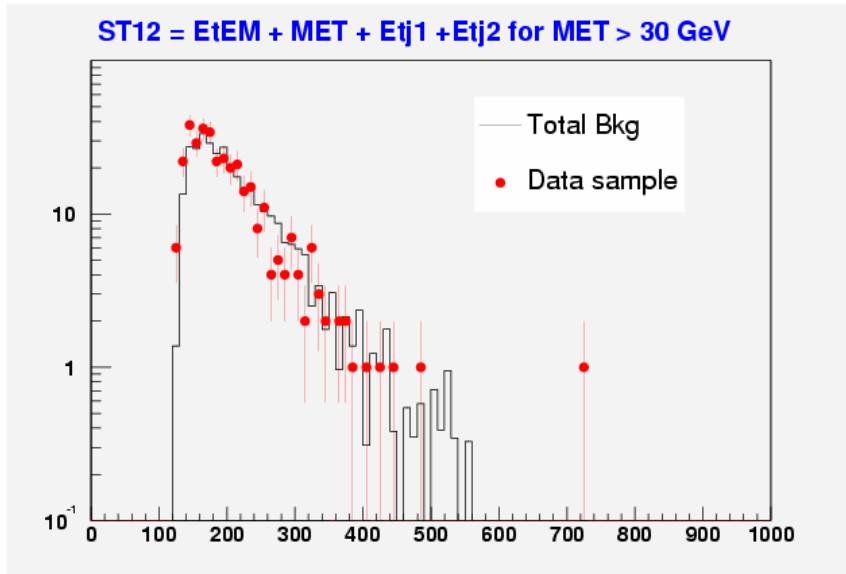
(LP03)

Alexis Cothenet
Marie-Claude Cousinou
Greg Landsberg

2nd generation leptoquarks search: $\mu j\ \mu j$
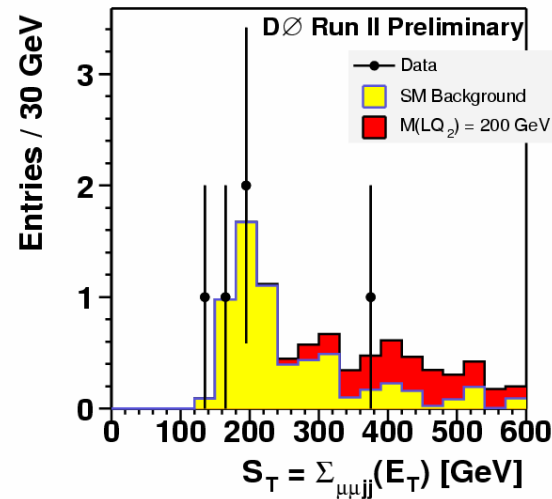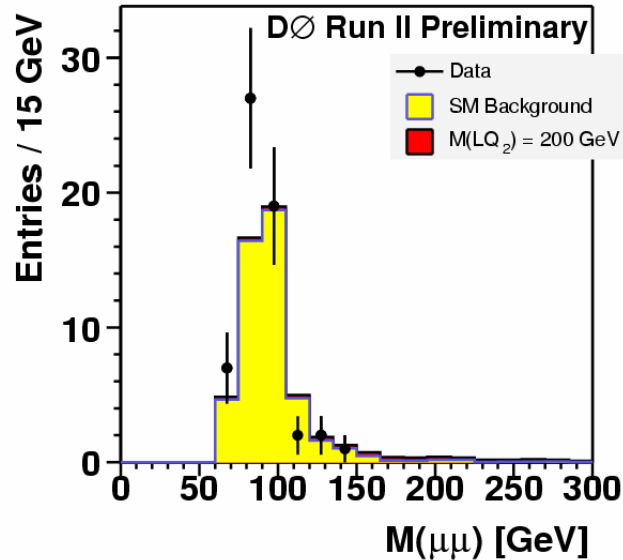
Tim Christiansen

(LP03)

QCD-**NP**-B   Christos Leonidopoulos
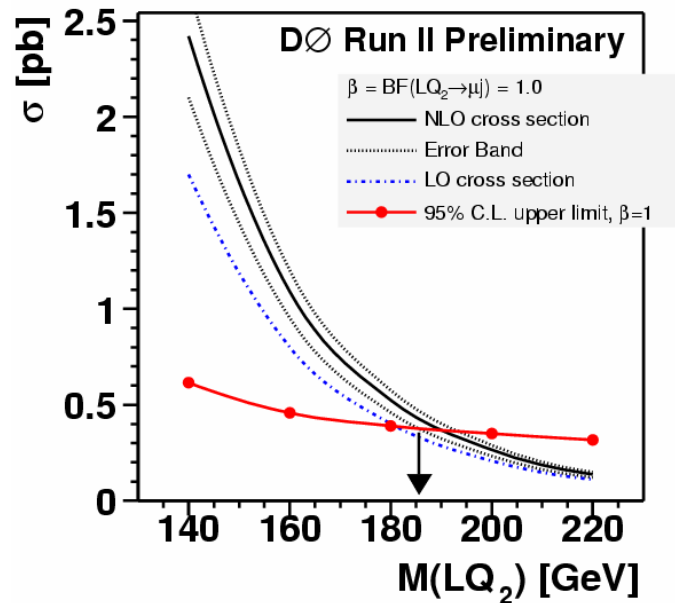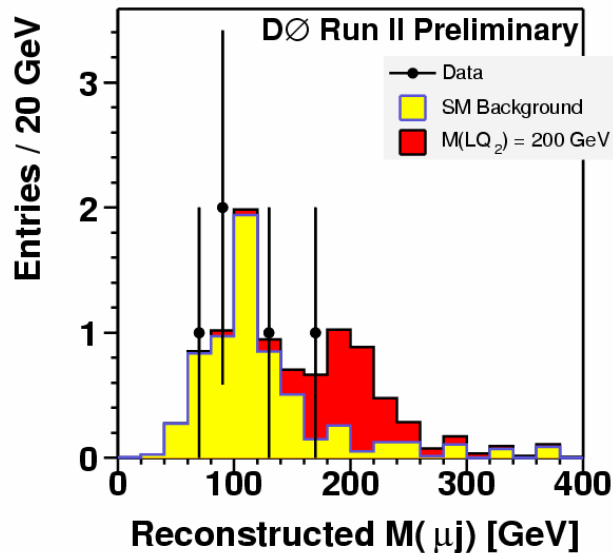
Charginos & neutralinos in trileptons
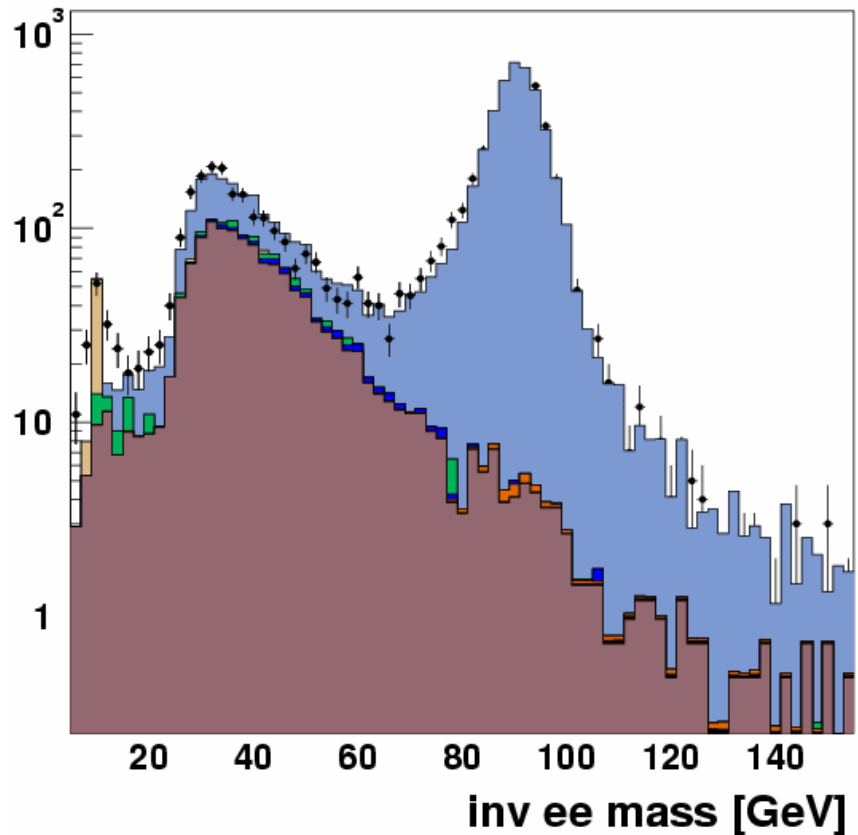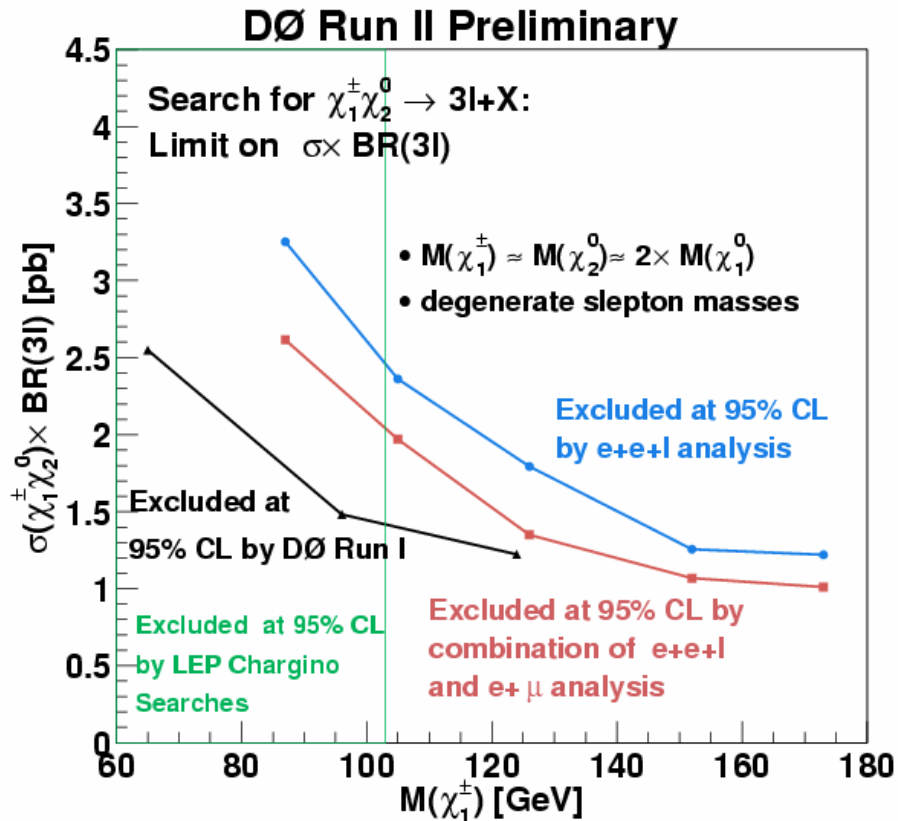
Ulla Blumenschein
Volker Buescher

(LP03)

Search for RpV SUSY in trielectrons

(a.k.a λ_{121} coupling)
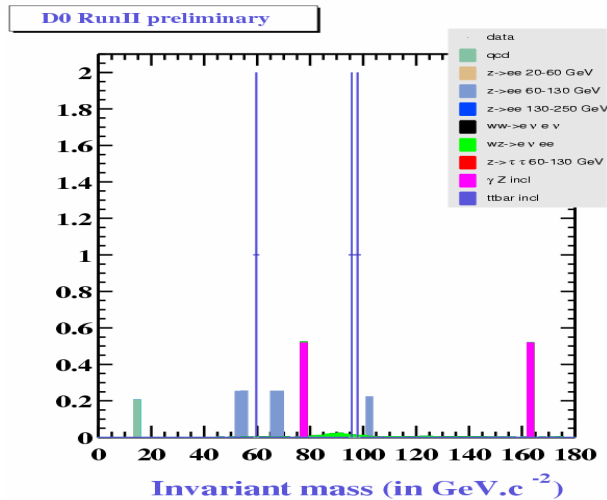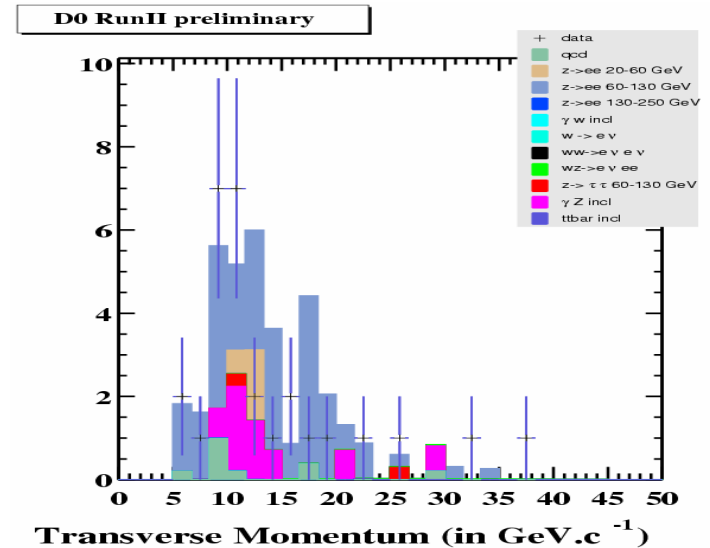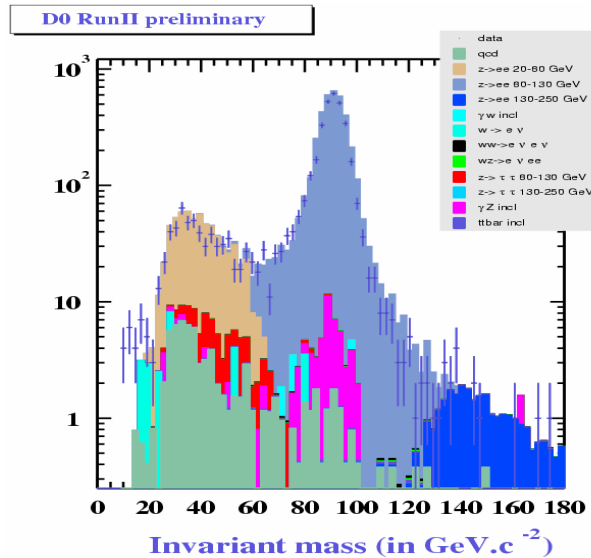
Anne-Marie Magnan
Gerard Sajot

(LP03)

Search for GMSB SUSY: $\gamma\gamma$ w/ large $\not{E}_T$
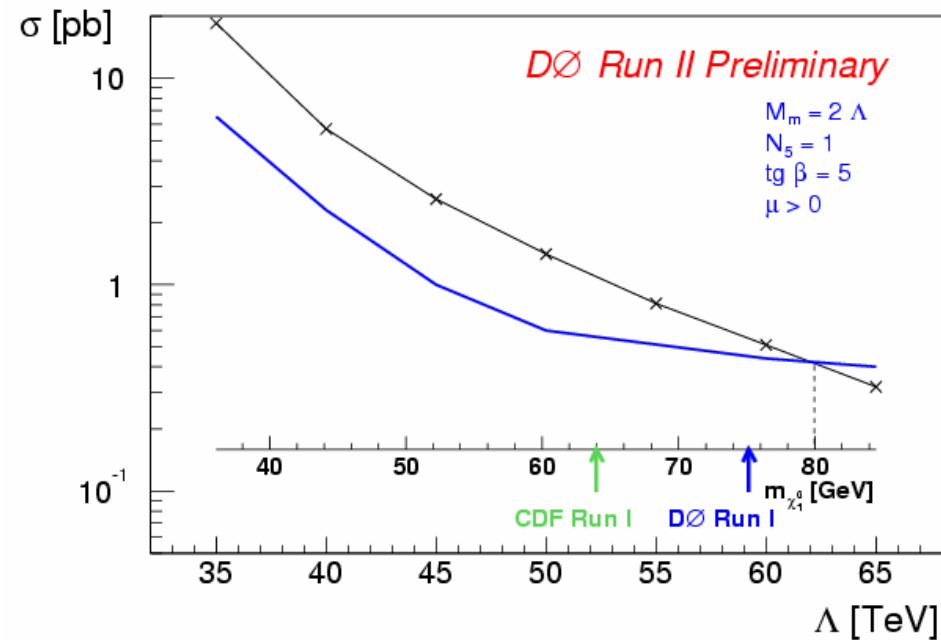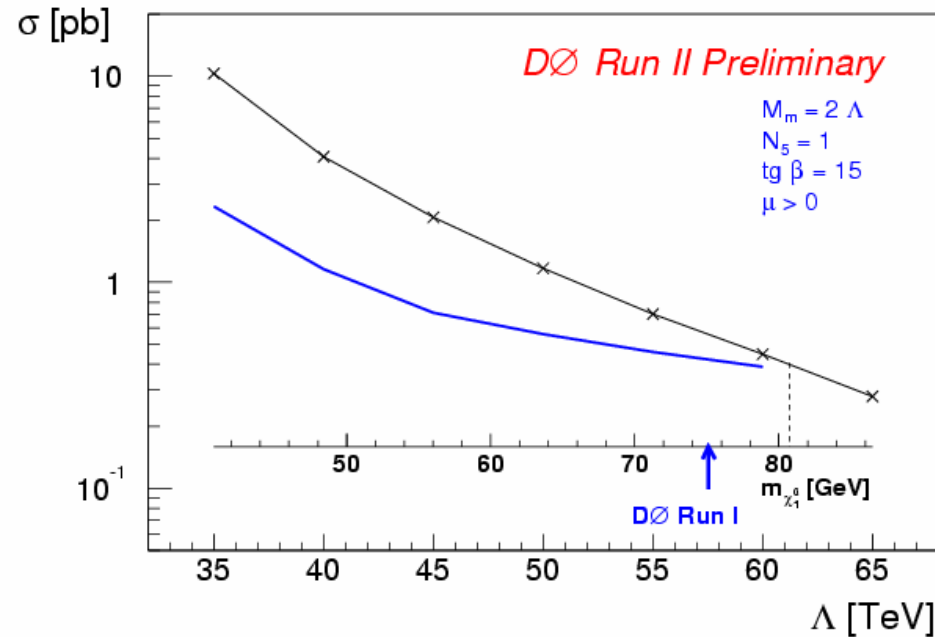
Yuri Gershtein
Stilianos Kesisoglou

(LP03)

Search for heavy resonances: $\mu^+\mu^-$
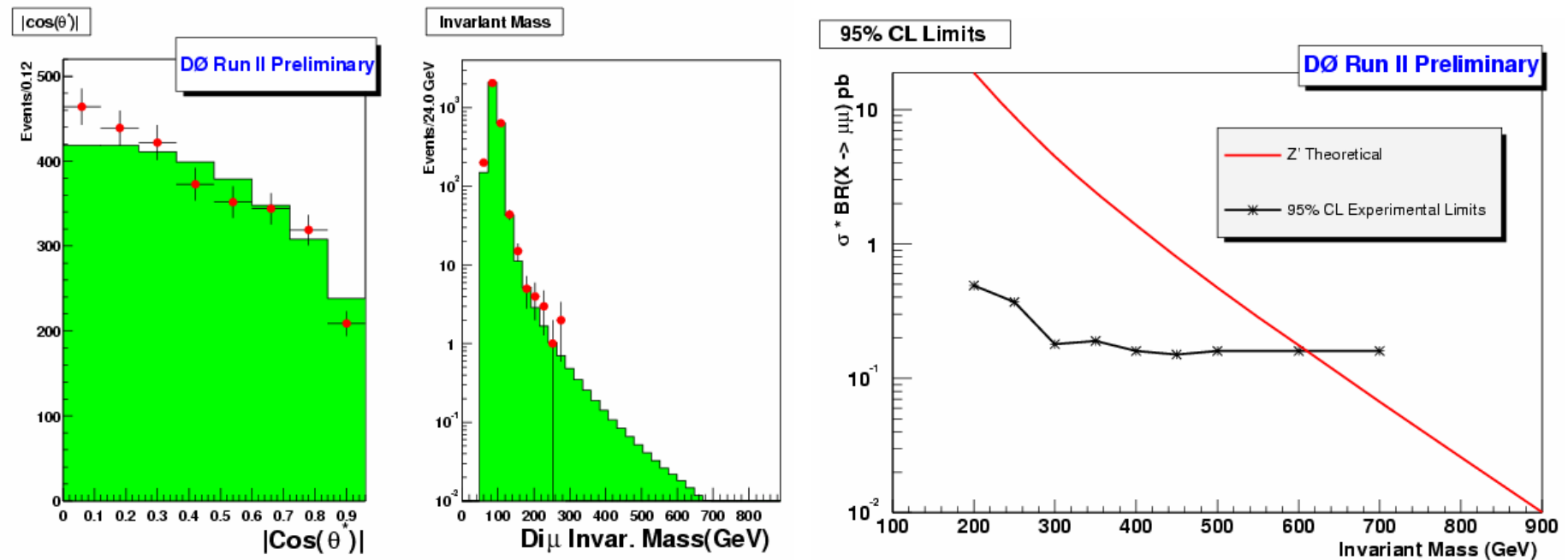
Ryan Hooper
Greg Landsberg

(LP03)

Model independent search for NP: $e\mu$
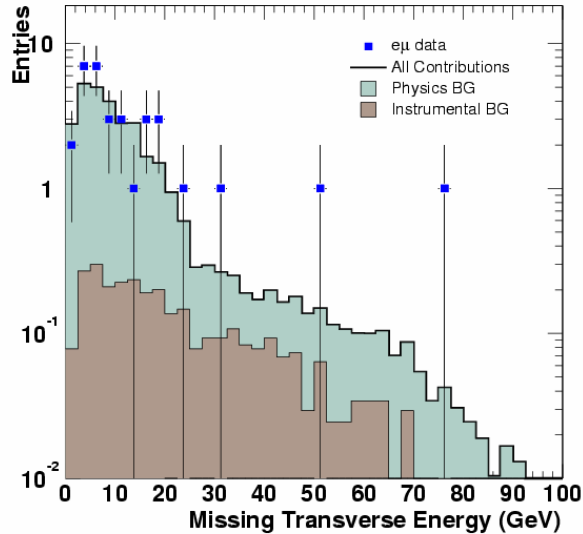
$e\mu$

$e\mu+j$

(LP03)

Daniel Whiteson

QCD-NP-B   Christos Leonidopoulos
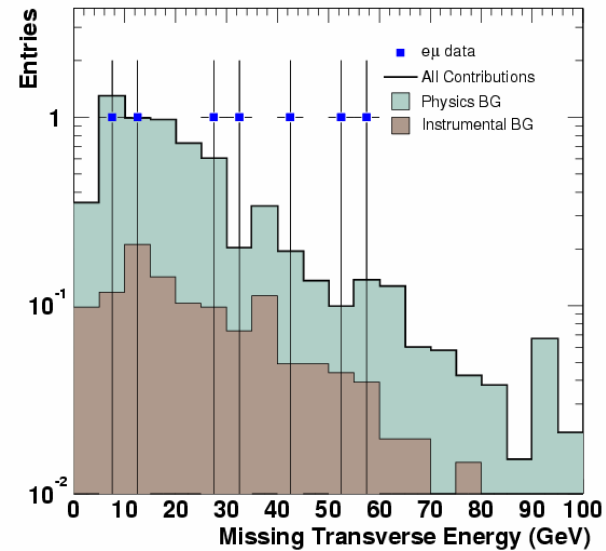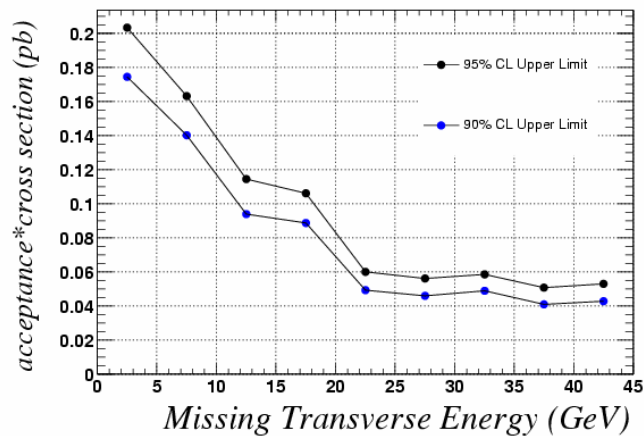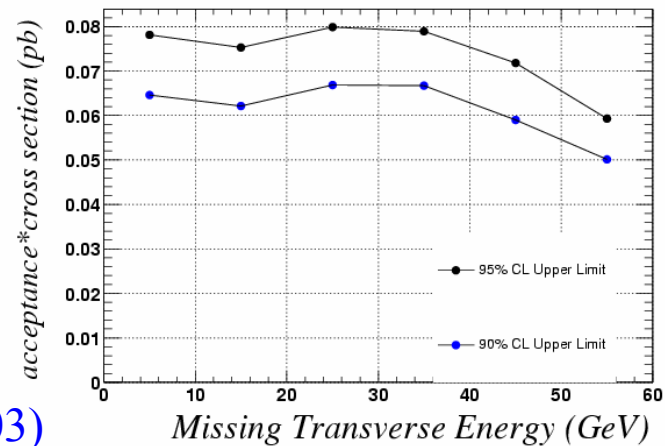
B Physics
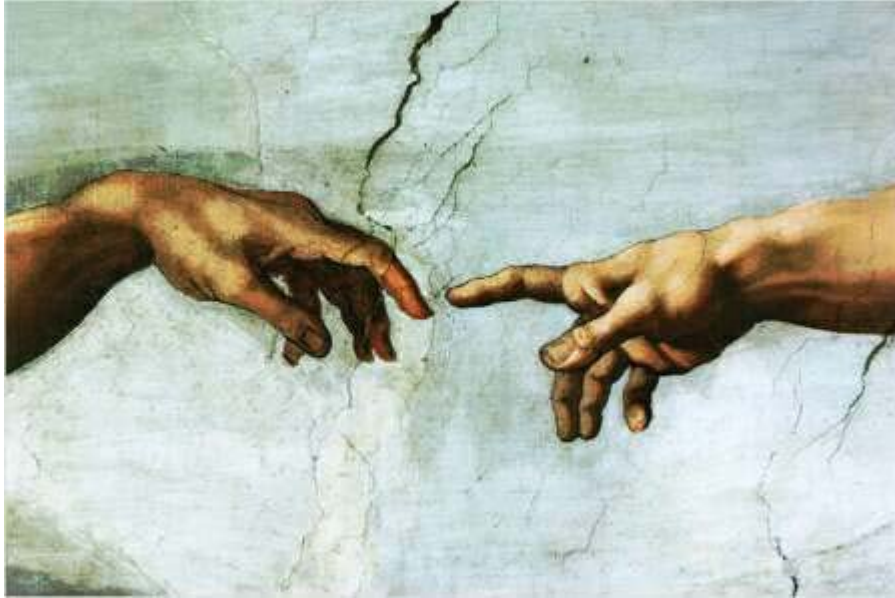
"The Beauty is within"

B lifetimes (1)

Inclusive B Lifetime

- Data
- Sideband
- B Signal
- B Signal + background

$\tau_{\mathrm{B}} = 1.562 \pm 0.013 \,(\text{stat}) \pm 0.028 \,(\text{sys})\ \text{ps}$

$B \rightarrow J/\psi + X$

B⁺ Lifetime

- DØ data
- Total Fit
- B+ signal
- Background

$\tau_{\mathrm{B}} = 1.65 \pm 0.08 \,(\text{stat})\ ^{+0.12}_{-0.08} \,(\text{sys})\ \text{ps}$

$B^{\pm} \rightarrow J/\psi + K^{\pm}$
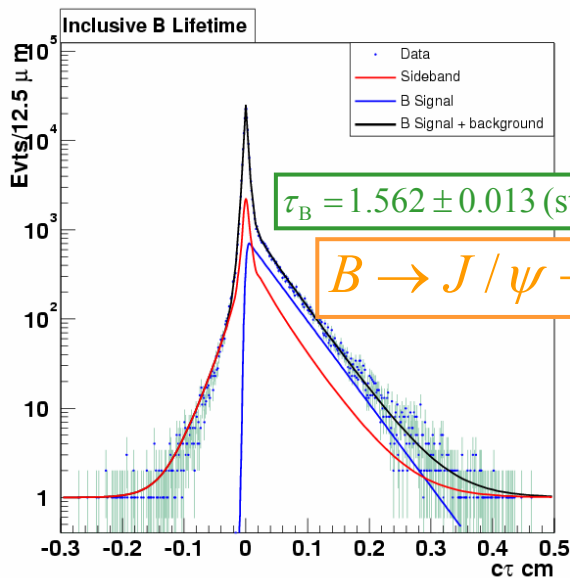
- Lots of people involved:

  Eduard De La Cruz-Burelo
  Pedro Luis Manuel Podesta
  Brendan Casey
  Chunhui Luo
  Daria Zieminska
  Abaz Kriemadhi
  Rick Van Kooten

$B_s \rightarrow J/\psi\ \phi$

- Data
- Total Fit
- Signal
- Background

$B_s \rightarrow J/\psi\ \phi$

$\tau_{\mathrm{B}} = 1.19\ ^{+0.19}_{-0.16} \,(\text{stat}) \pm 0.14 \,(\text{sys})\ \text{ps}$

$\tau_{\Lambda_b} = 1.05\ ^{+0.21}_{-0.18} \,(\text{stat}) \pm 0.12 \,(\text{sys})\ \text{ps}$

$\Lambda_b \rightarrow J/\psi\ \Lambda$

problems w/ long-lived bgd levels; investigating
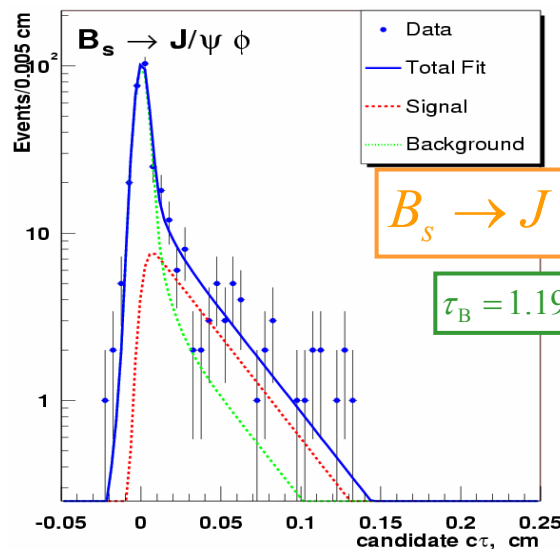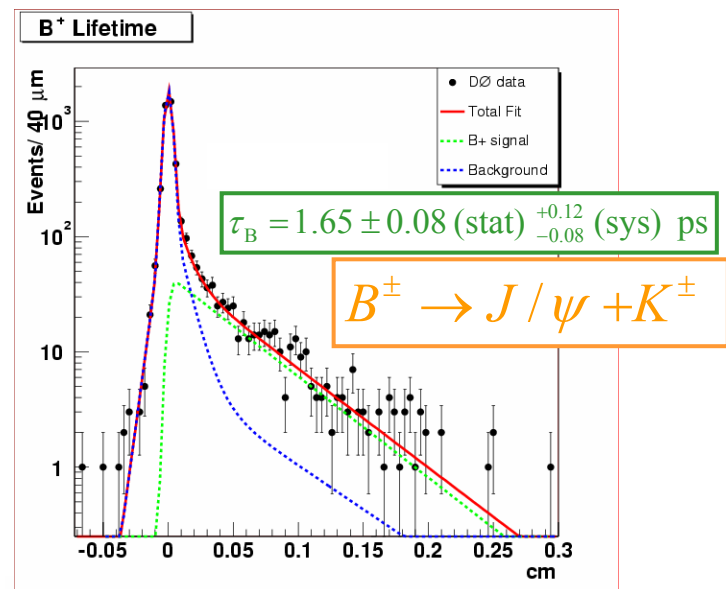
- Very advanced analyses (tracking/vertexing)
- Aiming for publication at end of 03/beginning of 04 (working on systematics)
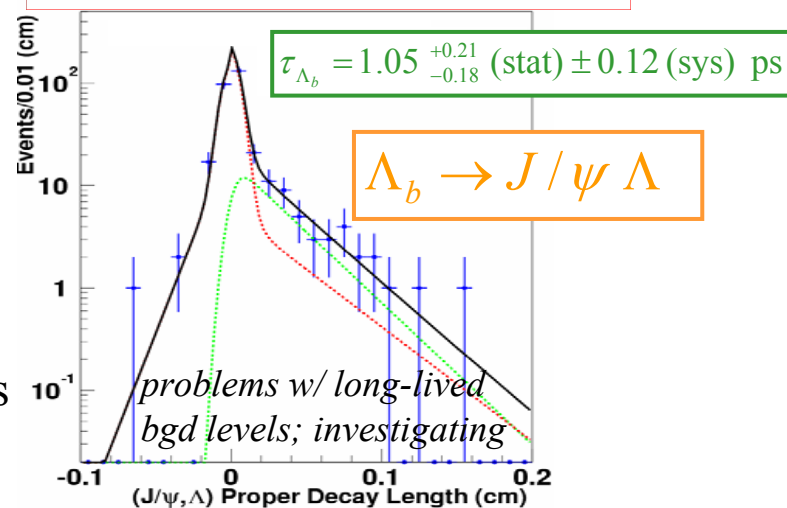
Upsilon cross section
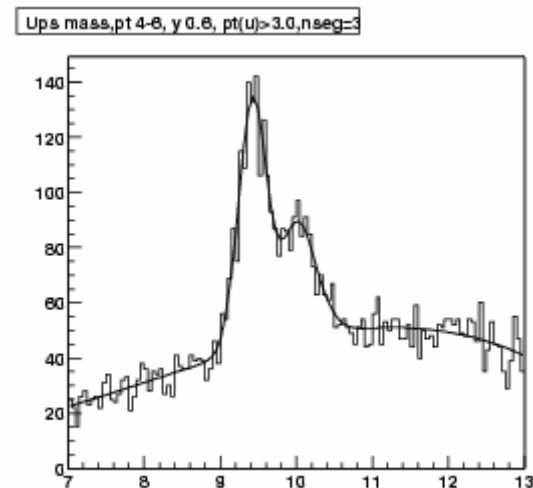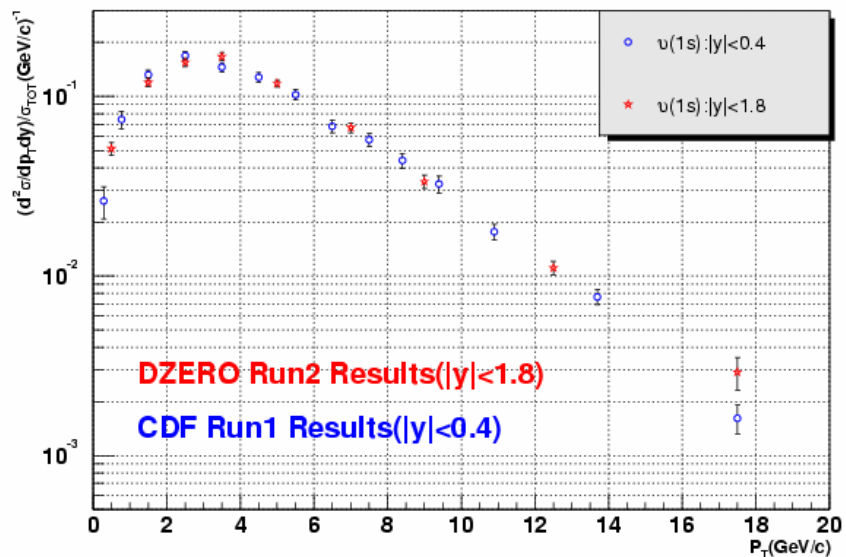
Dimuon invariant mass

Measurements in
extended rapidity region!
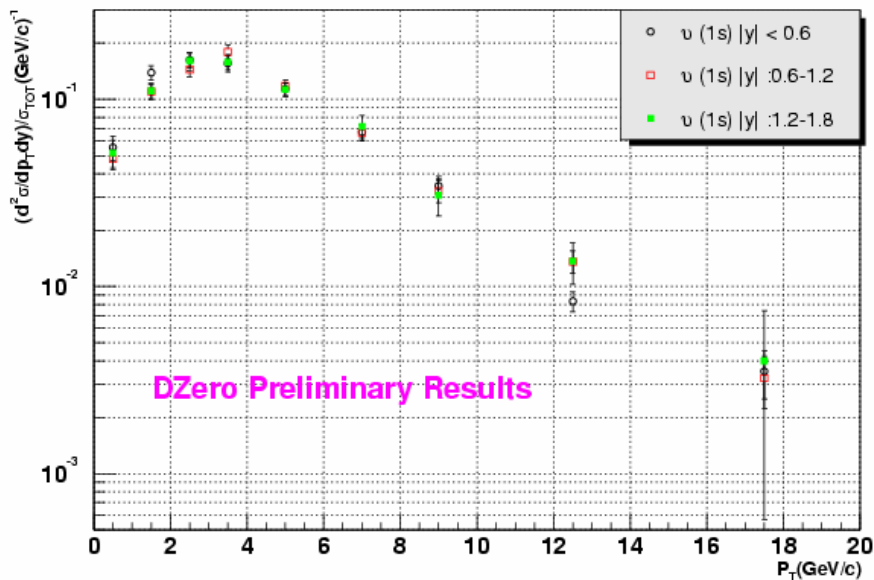
Daniela Bauer

Jundong Huang

Andrzej Zieminski

Shown at QWG 03 workshop

B_S mixing reach: The Über Formula

Statistical significance:

$$S(\Delta m, \sigma_t) = \sqrt{\frac{\varepsilon D^2 N}{2}} \sqrt{\frac{S}{S+B}} \times e^{-(\Delta m \sigma_t)^2/2}$$

Flavor tagging

# of reconstructed events

Signal purity

Proper time resolution

Having a good understanding of all the above factors means that we are confident about the Δm_S reach of DØ

- High-profile analysis
- Many tasks, lots of people involved
- *This is not a sprint, this is a marathon (run at sprint rates)!*

B semileptonic mass peaks

Current yield: ~ 560 events × pb

Current yield: ~ 30 events × pb

Guennadi Borissov

These plots: 7x statistics compared to LP03

B lifetimes (2)

B->D⁰μ X Lifetime

12 pb⁻¹

- D∅ data
- Total Fit — Signal — Background

$\tau_B = 1.460 \pm 0.083 \,(\text{stat}) \,\text{ps}$

$$B \rightarrow D^0 \mu + X$$

D0 RunII Preliminary, Luminosity = 43 pb⁻¹

$(\tau^+ - \tau^0)/\tau^+ = 0.087 \pm 0.019$

$$\frac{(B \rightarrow D^0 \mu + X)}{(B \rightarrow D^{*\pm} \mu + X)}$$
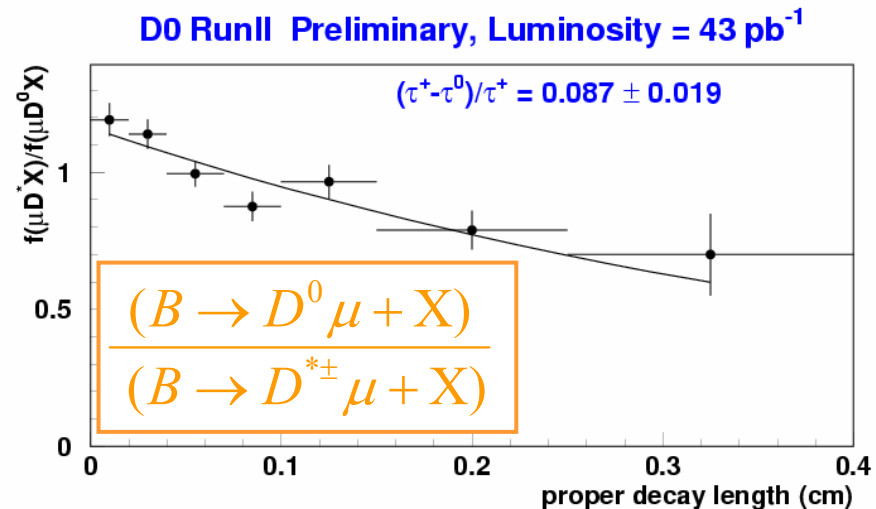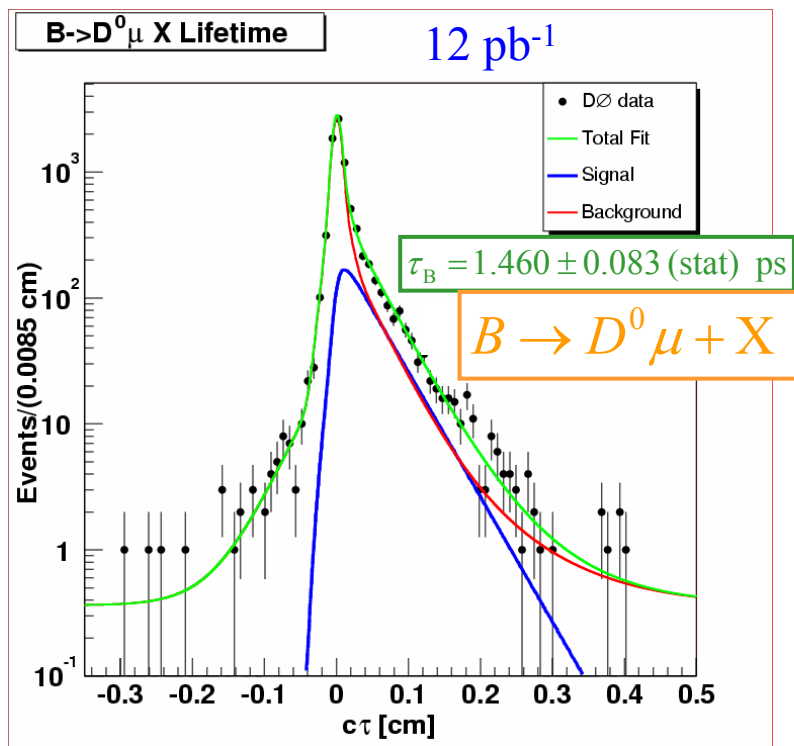
Guennadi Borissov
Sergey Burdin
Andrei Nomerotski

Not shown outside D0 yet

Brad Abbott, Tulika Bose, Vivek Jain
Christos Leonidopoulos, Wendy Taylor

First B semileptonic lifetime
measurement from TeVatron! (LP03)

B flavor tagging

$$b \rightarrow \ell^- X \qquad Q_j = \frac{\sum q_i \, \vec{p}_i \cdot \hat{a}}{\sum \vec{p}_i \cdot \hat{a}} \qquad \begin{array}{l} B^{**} \rightarrow B^{\pm} \, \pi^{\mp} \\ \text{or } \pi \text{ from} \\ \text{fragmentation} \end{array}$$

Tagging method	Soft Muon	Jet Charge	Same Side	Total
Efficiency ε (%)	5.0 ± 0.7	46.7 ± 2.7	79.2 ± 2.1	
Dilution D (%)	57.0 ± 19.3	26.7 ± 6.8	26.4 ± 4.8	*in the works…*
Tagging power $\varepsilon \times D^2$ (%)	1.6 ± 1.1	3.3 ± 1.7	5.5 ± 2.0	

(LP03)   (LP03)   This one just in!

Christos Leonidopoulos   Xiaojian Zhang   Avdhesh Chandra Jim Fast   Matt Doidge

Efficiency $\varepsilon = \dfrac{N_{\text{correct}} + N_{\text{wrong}}}{N_{\text{correct}} + N_{\text{wrong}} + N_{\text{no tag}}}$

Dilution $D = \dfrac{N_{\text{correct}} - N_{\text{wrong}}}{N_{\text{correct}} + N_{\text{wrong}}}$

Relevant for significance of mixing measurement

Tagging power : $\varepsilon \times D^2$

D0 RunII Preliminary

#events in peak = 65 ± 17

$B^+ \pi^+$
$B^+ \pi$

$M(B^+, \pi^-) - M(B^+) = 0.426 \pm 0.016$ GeV.

$M(B^+, \pi) - M(B^+)$, GeV
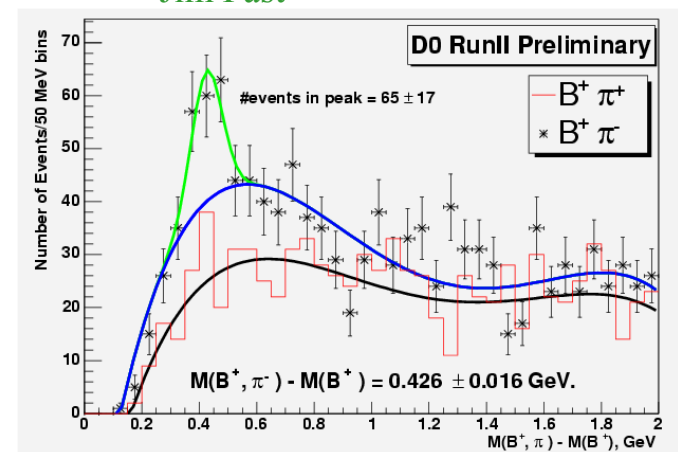
B_S mixing reach: 500 pb^{-1} projections

Single Muon Trigger:

$$B_S \to D_S^{\pm}\, \mu^{\mp}\nu\, X$$

Di-Muon Trigger: $\quad B_S \to D_S^{\pm}\, \mu^{\mp}\nu\, X$

(also single Muon Trigger and $\quad B_S \to D_S^{\pm}\, e^{\mp}\nu\, X \quad$)

current
Δm_s limit
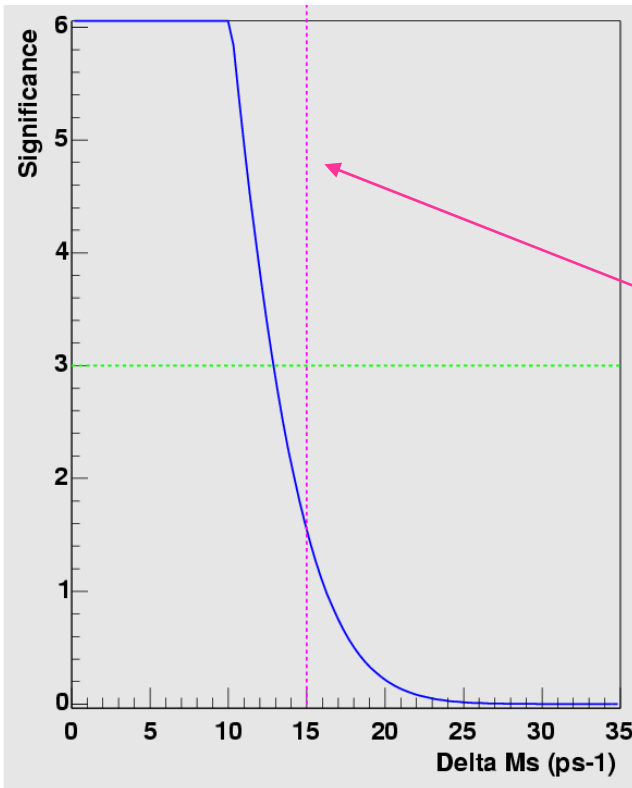
Vivek Jain

Yield – 15K $\quad \varepsilon D^2 = 0.1,\ \sigma_t \approx 150\,fs$
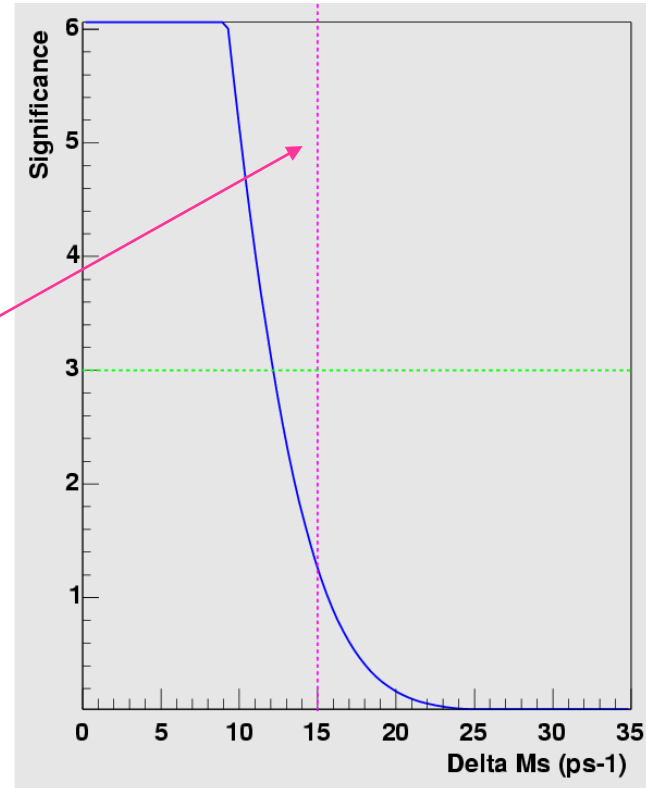
Yield – 2K $\quad \varepsilon D^2 = 0.5,\ \sigma_t \approx 150\,fs$

B physics triggers

- <u>Low-p_T, inclusive single-muon trigger</u>
  - Mainly used for $B_X \to D_X^{(*)} \mu \nu X$
  - Can also be used for $B_X \to D_X^{(*)} e \nu X$, $B_X \to D_X^{(*)\pm} \pi^{\mp}$
    (just muons for tagging)
  - Majority of events in mass peaks made it off-line thanks to single muon triggers
  - Turned off at higher luminosities…

- <u>Dimuon triggers</u>
  - Contributes to $B_X \to D_X^{(*)} \mu \nu X$ (especially for high luminosities)
  - The "sine qua non" for all J/ψ + X modes

- <u>Working hard to improve our triggers</u>
  - Focus on L3
  - Exploring the possibility of increasing DAQ bandwidth

Summary

- QCD:
  - Goals for Moriond: preliminary measurements on dN/dt, diffractive W/Z studies and jet cross sections
  - 3 publications by next summer

- New Phenomena:
  - Update analyses by end of 03 with p14
  - Publish in early 04 (leptoquarks?)

- B Physics:
  - B lifetime papers by end of year
  - Aim for Δm_d mixing measurement, first Δm_s lower limit by end of 03 – beginning of 04